INTERIM REPORT ON THE FEASIBILITY AND IMPLEMENTATION OF THE RELIABLE REPLACEMENT WARHEAD PROGRAM

Submitted to the Congressional Defense Committees in response to section 3111 of the National Defense Authorization Act for Fiscal Year 2006, Public Law 109-163, by the Secretaries of Defense and Energy in consultation with the Nuclear Weapons Council

March 1, 2006

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I. INTRODUCTION

A. Section 3111 of the National Defense Authorization Act for Fiscal Year 2006, Public Law 109-163 (2006), amended the Atomic Energy Defense Act (Division of Public Law 107-314 (2002)) by inserting after section 4204, a new section 4204a. This section establishes a requirement for the Secretary of Energy to carry out a program, to be known as the Reliable Replacement Warhead program, which will have the following objectives:

1. To increase the reliability, safety, and security of the United States nuclear weapons stockpile.

2. To further reduce the likelihood of the resumption of underground nuclear weapons testing.

3. To remain consistent with basic design parameters by including, to the maximum extent feasible and consistent with the objective specified in paragraph (2), components that are well understood or are certifiable without the need to resume underground nuclear weapons testing.

4. To ensure that the nuclear weapons infrastructure can respond to unforeseen problems, to include the ability to produce replacement warheads that are safer to manufacture, more cost-effective to produce, and less costly to maintain than existing warheads.

5. To achieve reductions in the future size of the nuclear weapons stockpile based on increased reliability of the reliable replacement warheads.

6. To use the design, certification, and production expertise resident in the nuclear complex to develop reliable replacement components to fulfill current mission requirements of the existing stockpile.

7. To serve as a complement to, and potentially a more cost-effective and reliable long-term replacement for, the current Stockpile Life Extension Programs.

B. Section 3111 (b) requires the Secretary of Energy and the Secretary of Defense submit to the congressional defense committees a report on the feasibility and implementation of the Reliable Replacement Warhead program not later than March 1, 2007. The report shall:

1. identify existing warheads recommended for replacement by 2035 with an assessment of the weapon performance and safety characteristics of the replacement warheads;

2. discuss the relationship of the Reliable Replacement Warhead program within the Stockpile Stewardship Program and its impact on the current Stockpile Life Extension Programs;

3. provide an assessment of the extent to which a successful Reliable Replacement Warhead program could lead to reductions in the nuclear weapons stockpile;

4. discuss the criteria by which replacement warheads under the Reliable Replacement Warhead program will be designed to maximize the likelihood of not requiring nuclear testing, as well as the circumstances that could lead to a resumption of testing;

5. provide a description of the infrastructure, including pit production capabilities, required to support the Reliable Replacement Warhead program;

6. provide a detailed summary of how the funds made available pursuant to the authorizations of appropriations in this Act, and any funds made available in prior years, will be used; and

7. provide an estimate of the comparative costs of a reliable replacement warhead and the stockpile life extension for the warheads identified in paragraph (1).

C. This report is submitted in response to section 3111 (c) which requires an interim report on these matters be submitted not later than March 1, 2006. This report has been prepared in consultation with the Nuclear Weapons Council.

II. BACKGROUND ON THE NEW PROGRAM

A. The current approach to nuclear stockpile sustainment - successive refurbishments of existing warheads that were developed during the Cold War - may not be the right path to achieve long-term sustainability of the stockpile. Specifically, the directors of the Lawrence Livermore, Los Alamos, and Sandia National Laboratories have raised concerns about their ability to assure the safety and reliability of the legacy stockpile indefinitely, absent underground nuclear testing. This concern is shared by the Commander, United States Strategic Command (USSTRATCOM), as advised by his Strategic Advisory Group's Stockpile Assessment Team. Evolution away from tested designs, resulting from the inevitable accumulations of small changes over the extended lifetimes of these highly-optimized systems, is what gives rise to this concern. Also important, warhead components designed, built, and fielded with 1970s technology are increasingly difficult and costly to remanufacture. Life Extension Programs (LEP) were carried out as a way to ensure the safety and reliability of the stockpile. It is prudent, however, to seek alternative approaches to mitigate concerns about stockpile safety and reliability over the long-term.

B. The goal of the Reliable Replacement Warhead (RRW) program is to assure, over the long term, the Nation's ability to sustain the nuclear stockpile with replacement warheads that provide the same military capabilities as the warheads they replace. These warheads could be more easily manufactured, with readily available and more environmentally benign materials, and whose safety and reliability could be maintained with high confidence without underground nuclear testing. Additional goals of the RRW program are to enhance the security of nuclear weapons and provide an enabler for the development of a responsive and capable infrastructure.

C. On March 23, 2005, based on the joint recommendation of USSTRATCOM Strategic Advisory Group, the Assistant Secretary of Defense for International Security Policy, the Assistant to the Secretary of Defense for Nuclear and Chemical and Biological Defense Programs, and the Nuclear Weapons Council (NWC) approved a joint Department of Defense (DoD) and National Nuclear Security Administration (NNSA) study to examine the feasibility of the RRW. The objective of the RRW study is to identify designs that will sustain long-term confidence in a safe, secure, and reliable stockpile and enable transformation to a responsive nuclear weapons infrastructure. The NWC formed a joint RRW Project Officers' Group (POG), co-chaired by representatives from the Navy and Air Force. The RRW POG was tasked to oversee an NNSA laboratory design competition for the RRW with the planned first production in approximately 2012. The feasibility study began in May 2005 and is on schedule to be completed in November 2006. One of the considerations of the RRW program is to achieve a design that could be used for both Submarine-Launched Ballistic Missile (SLBM) and Intercontinental Ballistic Missile (ICBM) applications. The POG will assess the technical feasibility of laboratory design concepts including the ability to certify without underground nuclear testing, potential impacts on transformation of the nuclear weapons infrastructure, and an initial life cycle cost estimate.

III. REPORTING REQUIREMENTS. Section 3111(c) requires the interim report to cover each of the following under section 3111(b):

A. *"Existing warheads recommended for replacement by 2035 with an assessment of the weapon performance and safety characteristics of the replacement warheads."*

1. As part of a larger transformation strategy, all existing legacy warheads will be studied for the feasibility of their replacement over the next 25-30 years in lieu of life extension. The ongoing RRW program is specifically examining the potential to replace a portion of W76 warheads on SLBMs, and considering compatibility of these warheads with ICBMs. The NWC, using the results from the ongoing RRW POG feasibility study, will establish the approach that will be adopted for integrating a warhead replacement concept into the long-term stockpile strategy.

2. A key feature of the basic RRW concept involves the reprioritization of many of the traditional weapon design parameters imposed by Cold War mission needs. As a result, production processes and materials can be used that will reduce known sources of performance margin uncertainty. Improved warhead performance margins will sustain confidence in reliability, reduce uncertainty due to long-term aging, and reduce the likelihood that underground nuclear testing will be required in the future to resolve a technical problem in the stockpile.

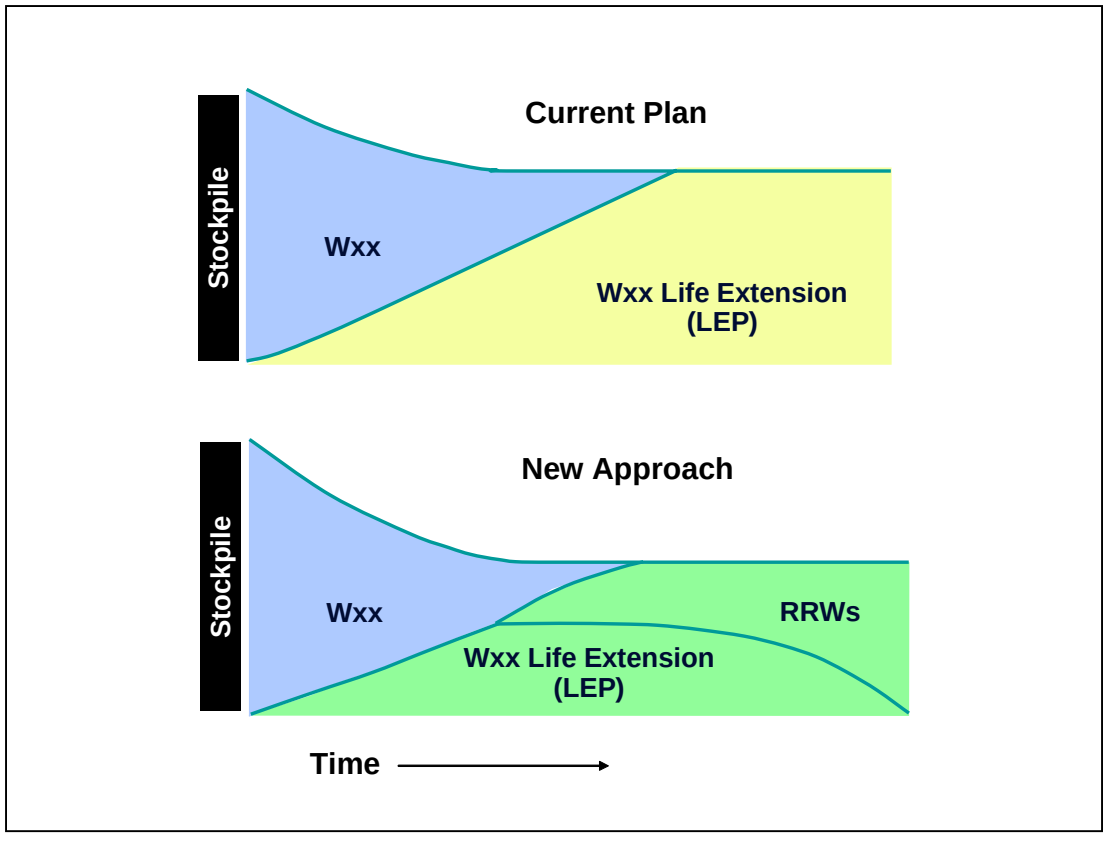
3. In addition to improved performance margins, enhancements in nuclear safety, security, and use control are at the top of the design priorities for all future replacement warhead candidates. The inclusion of modern, enhanced safety features in the stockpile will raise safety to a significantly higher level. The RRW feasibility study is investigating design concepts that are highly tolerant to shock, heat, electro-static discharge, and other abnormal environments to minimize further the possibility of accidental nuclear detonation. The RRW program also addresses the need for increased levels of warhead security and use control, and the concept designs will include enhanced features to provide these capabilities.

B. *"The relationship of the Reliable Replacement Warhead program within the Stockpile Stewardship Program and its impact on the current Stockpile Life Extension Programs."*

1. During the 1990s, the United States began a self-imposed moratorium on underground nuclear testing and moved its nuclear weapons program away from efforts to develop and produce new nuclear warheads. The main focus of the nuclear weapons program shifted to sustaining existing warheads for the indefinite future. The Department of Energy adopted a science-based Stockpile Stewardship Program to address this challenge. This program emphasizes the development and application of improved technical capabilities to assess the safety and reliability of existing nuclear warheads without the use of underground nuclear testing. These include advanced engineering, physics, subcritical experiments and other material property tests, advanced computation and modeling, and advanced surveillance and predictive capabilities for aging phenomena associated with nuclear weapons materials and

components. These improved capabilities have been used by the nuclear weapons design and manufacturing community to provide a report to the President for the last nine years, stating that the United States' nuclear stockpile is safe and reliable and no underground nuclear testing is required. Similarly, these capabilities are used in the conduct of warhead life extension refurbishment programs. The capabilities developed in the Stockpile Stewardship Program will provide a basis to establish the highest possible confidence in RRW designs and legacy warheads over the long-term.

2. The LEPs are essential for meeting near-term needs for a safe and reliable nuclear weapons stockpile. Successive LEPs of the legacy warheads, however, may not be a viable approach to ensure high confidence in a safe and reliable stockpile for the indefinite future. Additionally, LEPs do not allow for significant security enhancements to be incorporated into existing, highly optimized warhead designs. The NWC is evaluating options for future legacy warhead refurbishment and/or replacement. Along with the results from the ongoing RRW feasibility study, this evaluation will help to determine an integrated approach for transformation of the stockpile. While the viability of eventually replacing LEPs with RRW builds is still being examined, the NWC hopes that this approach will provide an alternative long-term stockpile strategy.



C. *"An assessment of the extent to which a successful Reliable Replacement Warhead program could lead to reductions in the nuclear weapons stockpile."*

1. The United States nuclear enterprise relies on a hedge strategy to provide risk reduction in the event that a major technical issue appears in the deployed stockpile or if geopolitical conditions rapidly deteriorate. Both a responsive infrastructure and non-deployed stockpile are components of the hedge strategy, and together they provide confidence that warheads will be available to augment or replace the warheads in the deployed stockpile, if needed.

2. Because today's nuclear infrastructure, however, is not fully responsive, the current implementation of the hedge strategy relies heavily on a large non-deployed stockpile. The nuclear weapons stockpile is old and requires maintaining an extensive, expensive, and aging infrastructure, demanding more resources than are expected to be available in the future. In the long-term, this approach will likely be unsustainable. A continued reliance on legacy warhead designs will result in potentially increased uncertainty in warhead safety and reliability, a limited potential to integrate enhanced safety and security features into the stockpile, and a continuation of many of the hazardous materials and outdated processes used for manufacture which, as a result, will make it much more difficult to implement a responsive nuclear infrastructure.

3. The RRW concept is one approach to ensure long-term confidence in the deployed stockpile and could enable transformation of the infrastructure to be more responsive and less reliant on legacy materials and processes. The non-deployed stockpile and infrastructure components of the hedge strategy could then be re-balanced. With sustained high confidence in the deployed stockpile and a more responsive infrastructure, enabled by RRW, the size of the non-deployed stockpile, which is now used to mitigate the effects of a technical failure or geopolitical change, could be reduced. Thus, RRW becomes a potential vehicle for implementing the strategy envisioned in the 2001 Nuclear Posture Review, which emphasizes infrastructure as a key element of a responsive, capable nuclear deterrent. The quantitative effects of sustained high confidence in the stockpile need to be evaluated as part of the on-going RRW program and the broader transformation strategy.

D. "*The criteria by which replacement warheads under the Reliable Replacement Warhead program will be designed to maximize the likelihood of not requiring nuclear testing, as well as the circumstances that could lead to a resumption of testing."*

1. The major goal of the RRW program is to ensure long-term confidence in the safety, security, and reliability of the nuclear stockpile without underground nuclear testing. The design laboratories have over sixty years of experience designing nuclear warheads and have conducted more than one thousand nuclear tests, including 150 nuclear tests of modern weapon types. A large amount of underground nuclear test data exists on the performance of weapons components. Using this archived data, the

laboratory designers have gained insight into key performance elements for tested designs.

2. The RRW design will be tied to previous nuclear test experience. As noted earlier, improved warhead performance margins that will be incorporated into the design will sustain long-term confidence in reliability, reduce uncertainty due to aging, and reduce the likelihood that underground nuclear testing will be required in the future to resolve a technical problem in the stockpile. Years of experience studying materials and manufacturing processes, and with capabilities developed as part of the NNSA's Stockpile Stewardship Program, combined with past nuclear test data, provide a basis for designers to address known areas of uncertainty.

E. *"A description of the infrastructure, including pit production capabilities, required to support the Reliable Replacement Warhead program."*

1. The DoD and NNSA are working to establish requirements for total quantity and annual production rates of RRWs to determine the required manufacturing infrastructure, especially for pit manufacturing capability and capacity. The NNSA anticipates the RRW design could be manufactured and produced in limited quantities using capabilities currently existing or under development within the complex. However, a manufacturing capacity for RRW pits well beyond the 30-40 per year capacity envisioned for Los Alamos in 2012 will be essential in the long-term for both stockpile transformation and the responsive infrastructure that is needed to potentially reduce the quantity of non-deployed warheads. The other infrastructure requirements to support the program include but are not limited to: experimental facilities to develop and conduct material property tests; engineering, physics, and subcritical experiments; modeling and simulation capabilities; manufacturing process development for components; uranium processing capability and capacity; and warhead assembly and disassembly facilities.

F. *"A detailed summary of how the funds made available pursuant to the authorization of appropriations in this Act, and any funds made available in prior years, will be used."*

1. The RRW program was authorized in Fiscal Year (FY) 2005 and appropriated $9 million for that year. The program was appropriated $25 million for FY06.

   a. FY05 Activities and Accomplishments

      i. Established the POG to lead a competitive feasibility and cost evaluation of the RRW program with a first production goal of FY2012.

      ii. Identified Military Characteristics (MCs) for RRW to maintain existing military capability and to support infrastructure and stockpile transformation.

iii. Tasked the NNSA laboratory-plant design teams to proceed with conceptual designs of a RRW that offer enhancements to safety, security, and use control and can be certified with high confidence without nuclear testing.

iv. Reviewed RRW conceptual designs to maintain existing military capability.

v. Established a basis for evaluation criteria to select an RRW design for development, to include ease of manufacture.

vi. Identified an approach for a comparative cost assessment of RRW compared with current LEPs.

b. FY06 Objectives

i. Issue Interim Report to Congress on the Feasibility and Implementation of the RRW program.

ii. Ensure compatibility between NNSA and DoD interfaces.

iii. Continue conceptual design work by laboratory-plant teams to complete preliminary design data packages in March 2006.

iv. Develop draft certification strategies for design options.

v. Conduct preliminary production facility evaluations of the design options for feasibility of manufacturing.

vi. Finalize evaluation and design selection criteria to include cost, ease of manufacture and certification, and to assess risk of meeting first production within cost and on schedule.

vii. Complete interlaboratory peer reviews and evaluations of design options.

viii. Complete POG assessment of design options and formulate recommendation to the NWC to support a decision on a single RRW design concept.

G. *"The comparative costs of a reliable replacement warhead and the stockpile life extension for the warheads identified in paragraph (1)."*

1. Cost estimates for the RRW program have not yet been developed, but some general comparison of current LEPs and the RRW program can be made. LEPs reuse major components, including pits, requiring the continued use of certain hazardous materials. The RRW program will develop replacement components, including a pit, and will investigate the tradeoffs and feasibility of using less hazardous materials than in legacy systems**.** This approach has the potential to reduce comparative life

cycle costs. Also, manufacturing constraints will be less stringent for the RRW because of increased design margin in performance.

2. The design intent of the RRW program is to incorporate enhanced safety and security into the warhead, which will incur some additional cost. However, this is expected to result in efficiencies in assembly, maintenance, surveillance, and dismantlement operations. These improvements may also introduce opportunities for savings in the transportation, storage, and maintenance of nuclear weapons. The analyses of the enhanced safety and security aspects of the RRW need to be completed in greater detail to establish the nature and scope of efficiencies that can be achieved. A major task of the RRW POG is to examine the life cycle costs of an RRW concept and report these estimates to the NWC. The NWC will then have the basis for a cost comparison between an RRW and an LEP, and will provide more details on this question in the final report to Congress, due March 1, 2007.

IV. CONCLUSION

A. The current approach of life extension of legacy warheads for nuclear stockpile sustainment may not be the right path to achieve long-term sustainability. Section 3111 of the National Defense Authorization Act of Fiscal Year 2006 amended the Atomic Energy Defense Act by establishing a requirement for the Secretary of Energy to carry out a program known as the RRW program. The goal of the RRW program is to assure, over the long-term, high confidence in the stockpile without underground nuclear testing for as long as the United States requires nuclear forces. A final report on the feasibility and implementation of the RRW program will be submitted to the congressional defense committees not later than March 1, 2007.